Aberdeen Proving Ground, White Phosphorus Processing Plant HAER No. MD-47A
(Edgewood Arsenal, White Phosphorus Processing Plant)
Northwest corner of Hoadley and Magnolia Roads
Aberdeen
Harford County
Maryland

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
MID-ATLANTIC RECION, NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
PHILADELPHIA, PENNSYLVANIA 19106

HAER MD, [illegible]

HISTORIC AMERICAN ENGINEERING RECORD

ABERDEEN PROVING GROUND, WHITE PHOSPHORUS PROCESSING PLANT (EDGEWOOD ARSENAL - WHITE PHOSPHORUS PROCESSING PLANT)

HAER No. MD-47A

Location:	Building E5032 (Formerly Building 99) Northwest corner of Hoadley and Magnolia Roads in Aberdeen Proving Ground - Aberdeen Area (formerly Edgewood Arsenal), Harford County, Maryland. UTM: 18.388299.436174 Quad: Edgewood, Maryland
Date of Construction:	1918. Altered 1943, 1944.
Engineer/Architect/ Builder/Fabricator:	Original unknown. Alterations: Chemical Warfare Service, architects.
Present Owner:	Commander U.S. Army Aberdeen Proving Ground STEAP-DIC Aberdeen Proving Ground, MD 21005-5001
Present Use:	Vacant. Previously used for production of white phosphorus. Building scheduled for demolition.
Significance:	The building represents the response of the United States to the use of chemical weapons during World War I. It is the last remaining structure of the largest chemical manufacturing complex built in the United States.
Project Information:	This documentation was undertaken in May 1987 to support building demolition under guidance of the Advisory Council on Historic Preservation and the Maryland Historical Trust.

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Aberdeen Proving Ground, MD

The Aberdeen Proving Ground (APG) White Phosphorus (WP) Processing Plant, building number E5Ø32 (formerly building 99), was originally constructed in 1918. It was part of the largest chemical manufacturing complex built in the United States in response to the use of chemical weapons during World War I. (1) The building is situated in the cantonment area of the Edgewood Area of APG, Maryland (formerly Edgewood Arsenal), a U.S. Army installation. It is located at the corner of Hoadley and Magnolia Roads.

The WP Processing Plant is a one story rectangular building measuring 54 feet 6 inches by 76 feet 2 inches, with an offset 12 feet 3 inches by 49 feet 6 inches. The building has a concrete foundation, steel frame, and corrugated metal walls with some brick. It has a corrugated metal gable monitor roof, and the roof ridge runs northeast by southwest. There is one set of double wood side hinged doors, double wood and glass panel doors, and a band of wood framed two-over-two-light double hung sash windows. Metal shafts are located at the end of the building. Little, if any, original machinery exists in place. (2) Photographs of the building as it presently exists are located in the photographic documentation section of this report.

The Report on the Construction of the Filling Plants at Edgewood Plant of the Edgewood Arsenal describes original construction of Building 99 as follows:

INCENDIARY DROP BOMB FILLING BUILDING No. 99.

Capacity of Plant -- 2,ØØØ Mark I or Mark II Drop Bombs per day.

General Dimensions -- 53 Ø" x 75'Ø" centre to centre columns x 11'Ø" to bottom chord of trusses. Total height to ridge of monitor, 26'8". Monitor 11'Ø" wide x 8'Ø" high, and extending full length of building. Platform 9'Ø" x 9Ø'Ø" runs along front of building, and is raised 4'Ø" above finished floor line.

Foundations -- Concrete walls to 3'Ø" below grade. Interior columns on concrete pedestals to 3'Ø" below ground, and consist of 3'6" x 2'6" reinforced concrete mats 12" thick and 18" x 2'6" plinth.

Superstructure -- 5 Structural Steel Bents 15'Ø" o. c., with steel I Beams columns 12'Ø", 11'Ø" and 21'Ø" o. c. Galvanized corrugated from siding and roofing on channel girts and purlins. In monitor portion of building is a structural steel framework 12'

Ø" above floor which supports Mixing Tanks, Motors, Shafting, etc. 1/6 Pitch on side trusses and monitor roofs. Platform consists of 2" Plank on 6" I Beams, and carried by 12" I Beams.

Floors -- 6" Concrete Slab reinforced with expanded metal.

Windows -- Pivoted 15 light continuous sash, A. B. Co. Standard in monitor, on both sides, and in the two side elevations. Glazed with 1Ø x 12 glass.

Doors -- Front elevation: 6--3'Ø" x 6'6" sliding doors with track and brackets. Side elevation: 1--2'6" x 7'Ø" hinged door. Side elevation: 1--2'6" x 7'Ø" and 1--6'Ø" x 8'Ø" hinged doors and 2--6'Ø" x 1Ø'Ø" double swinging doors. One door with wicket. All doors of wood with steel frames.

Wiring -- All wiring installed in metal conduits.

The following equipment is installed and in operation:

2 12ØØ-gallon Mixing Vats, Steam-jacketed.
6 Type "A," Bowner Oil Pumps.
1 12ØØ-lb. Asphaltum Melting Pot.
1 1 H.P., G. E. Motor, 3 Phase, 6Ø Cycle, 22Ø Volts.
3 4Ø-gallon Steel Mixing Barrels.
1 4Ø-H.P. Vertical Water Tube Boiler.

COST OF LABOR AND MATERIALS.

Building Started April 27, 1918.
Building Completed July 15, 1918.
Machinery in Operation August 15, 1918.
Floor Area, 4225 square feet.
Cubical Contents, 83,817 cubic feet.

Excavation	5Ø Cu. Yds.			
Concrete	92 Cu. Yds.	@	$5.25.....	$483.ØØ
Expanded Metal 4	3ØØ Sq. Ft.	@	.Ø4.....	172.ØØ
Reinforcing Steel 9	973 Lbs.	@	.Ø41.....	4Ø8.89
Struct. Steel, including erection	33 Tons			11,2ØØ.ØØ

Doors, 635 sq. ft., included in above.
Windows, 1,188 sq. ft., included in above.
Roofing, 13,171 sq. ft., included in above.
Lumber, 1,5ØØ bd. ft., included in above.

Electrical Outlets ..... 24 @ $3.10 each 74.40
Other Materials 100.00

Total Material Cost $12,438.29

Total Labor Cost, including labor cost for installation of equipment as listed $14,834.67

Total Cost, Labor and Materials $27,272.96

INCENDIARY DROP BOMB STORAGE - BUILDING No. 99-A

General Dimensions -- 16'9" x 34'9" outside dimensions x 8'0" to bottom chord of trusses.

Foundations -- Concrete walls to 3'0" below grade.

Floor -- Dirt Floor.

Superstructure -- Portable Steel Building with sheet from siding and roofing on light structural steel frame.

Windows -- 2'0" x 4'0" double windows hinged at top and glazed.

Doors -- Single swing doors, 3'0" x 6'6", with wire glass panel.

Wiring -- All wiring installed in metal condults.

COST OF LABOR AND MATERIALS.

Building Started April 27th, 1918.
Building Completed, June 1st, 1918.
Floor Area, 558 square feet.
Cubical Contents, 5580 cubic feet.

Excavation ..... 20 Cu. Yds.
Concrete ..... 15 Cu. Yds. @ $5.25..... $ 78.75
Reinforcing Steel ..... 247 Lbs. @ .041..... 10.13
Struct. Steel,
including erection 3.3 Tons 758.00
Doors, 48 sq. ft., included in above.
Windows, 128 sq. ft., included in above.
Roofing and Siding, 1273 sq. ft., included in above.
Electrical Outlets ..... 3 @ $3.10 each 9.30
Other Materials 10.00

Total Material Cost	$ 866.18
Total Labor Cost	519.65
Total Cost, Labor and Materials	$ 1,385.83

MISCELLANEOUS ITEMS CHARGED TO FILLING PLANT No 1.

Steel Water Tower:
Standard Steel Water Tower, 50,000 gallons capacity, for fire service lines. Spherical bottom and conical roof. Supported on structural steel frame.

Concrete, 10 Cu. Yds. @ $5.25	$52.50
Tank and Structural Frame, including erection ..	6,000.00
Other Materials	25.00
Total Material Cost	$6,077.50
Total Labor Cost	201.00
Total Cost, Labor and Materials	$6,278.50

Sand Pits and Temporary Roads Leading to Same: Approximately 15,000 cu. yds. of sand removed and used in construction work.

Total Labor Cost $20,000.00 (3)

The corrugated metal sides and roof have rusted, rendering the appearance of the building very unsightly. The building has served the purpose for which it was constructed and cannot be adapted economically or practicably to any other beneficial use. The function in the building has been relocated to building E5188. The building may be contaminated from the WP operation. (4)

The WP Processing Plant was identified as having some historic significance during a survey of APG in 1982.(5) Two members of the survey team noted that it was deemed eligible for the National Register of Historic Places as part of an overall thematic nomination of such buildings associated with the production of WP. The thematic nomination was made not for architectural merit, but for historic and engineering-related use of these buildings. This use is no longer associated with this building, and has not been associated for many years. They feel that the WP Processing Plant has lost the characteristics which made it eligible for inclusion on the National Register. (6)

When the building was built in 1918, it was known as the Incendiary Drop Bomb Filling Plant. From 1919 until 1946 it was the filling building for the Technical command, and was used for tests, loading, mixing, and filling experiments. In 1943 and 1944 the building was altered to support this mission. Copies of engineering drawings related to these alterations are presented in the photographic documentation section of this report. Up to the 1960's it was used as a pilot plant and loading facility for miscellaneous munitions by Chemical Research and Development Laboratory (CRDL). In the mid-1960s it became the Pilot Plant for WP of the Weapons Development and Engineering Laboratory. In 1980, occupancy was transferred to the U.S. Army Armament Research and Development Command Support element.(8) While exact dates are uncertain, at sometime during the early 1980s functions were transferred to another building. The WP Processing Plant was moved to an inactive status and plans initiated for its demolition.

The output of the filling plants during WWI was limited greatly by the limited availability of bursters. The Incendiary Bomb Filling Plant was operated for only a short period of time, producing scatter and intensive type bombs, due to unsatisfactory bomb design and a shortage of thermite. Incendiary bombs were filled with mixtures made from kerosene, carbon bisulfide, turpentine, crude petroleum, benzene, asphaltum, stearic acid, thermite, alcohol and sodium hydroxide.(9) Smoke munitions were filled with WP and stannic chloride.

Operations of another building, Phosphorus Hand Grenade Building No. 68, were described in the Report on the Construction of the Filling Plants. While the Incendiary Drop Bomb Filling Plant is expected to vary slightly, the description of Building 68 is provided due to the similarity of WP operations.

PHOSPHORUS HAND GRENADE BUILDING No. 68.

This building was designed with the intention of installing three Filling and Closing Units for Phosphorous Hand Grenades with provisions for an additional unit, but on account of the termination of hostilities only the foundations for the machinery were installed.

Filling of Phosphorus Hand Grenades -- The grenades were filled in a two-compartment concrete tank so arranged that one compartment was at one end immediately above the other, the lower one being filled with water nearly to the edge, the level of the water being such that it came into contact with the bottom of the

upper tank, which had a sheet steel bottom and lining. A small centrifugal pump was provided to pump the phosphorous from the lower or filling basin to the upper melting tank. Each tank had independent overflows to the sewer, steam coils and water supply.

A tray holding 64 grenades was placed in the filling basin just under the surface of the water and phosphorous conducted through a rubber hose from the melting tank through a siamese nozzle into the grenades. This nozzle was operated by hand, and the grenades filled to overflowing; the supply to the nozzle was not cut off until all the grenades on the tray were filled. The overflow accumulated in the bottom, and was pumped back into the melting tank from time to time. The trayful of grenades was then removed from the filling basin and placed in a shallow hot water bath, where some of the phosphorous was removed by placing a suction nozzle a given distance (7/8") down into the grenade, the suction being produced by a small ejector operated by hot water drawn from the filling basin by the small centrifugal pump and returning its discharge of hot water and phosphorus into the basin again.

The tray was then moved along to the next operator, who dropped the detonator thimbles in and started the threads together. The tray passed from here along the water table to the closing machine, where a man placed the grenades one by one into the holding jig of the machine. After the thimble had been screwed home, the grenade was removed by the machine operator and dropped into a cold bath, from which it was picked and placed in its box upside down, so that any leak in the thread would soon show itself. From here on the phosphorous grenades received the same treatment as the Stannic Chloride grenades, stencilling, etc.

Rubber gloves were worn by all the men handling the phosphorous. Rubber hose, three to five-ply, was used in conducting the liquid phosphorus. (10)

During the 1920's and 1930's the building was maintained as a filling facility, with incendiary bombs being the product during at least the early portion of these two decades. The amount of filling work performed between WWI and WWII is not known, and no information is available regarding this building. (11)

It was during WWII that the majority of filling activities occurred at APG-EA. (12)

The scale of filling activities following WWII have been much smaller than during the war, and have concentrated on WP filling pilot studies. Other filling operations have involved mustard during the period shortly after WWII, and triethly aluminum (TEA). (13) The WP filling work has been with both wet and dry methods. (14) The wet methods have been used to the greatest extent. The dry method filling was accomplished primarily during the 1965-1970 timeframe. The filling operations in the WP Processing Plant terminated about 1981. (15)

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FOOTNOTES

[1]Katherine Grandine, "HABS/HAER Inventory Building E5Ø32 White Phosphorus Processing Plant," (Aberdeen Proving Ground, Maryland: August 1982).

[2]ibid.

[3]R.C. Marshall, Jr. and Edward B. Ellicott, Report on the Filling Plants at Edgewood Plant of the Edgewood Arsenal, EA-L-567, (Edgewood Arsenal, Maryland: March 1919), pp. 53-55.

[4]Ronald P. Cypher, "Request for Approval of Disposal of Buildings and Improvements, Building E5Ø32," (Aberdeen Proving ground, MD: September 1984).

[5]Katherine Grandine, Irene Jackson Henry, and William R. Henry, Jr., United States Army Development and Readiness Command Historic Building Inventory Aberdeen Proving Ground, Maryland, (National Park Service, Historic American Building Survey, Historic American Engineering Record: 1982).

[6]William R. Henry, Jr. and Irene Jackson Henry, "Letter of opinion regarding the white phosphorus building to Ken Stachiw," (Glen Riddle, Pennsylvania: May 1985).

[7]Gradine, Henry, and Henry.

[8]Jeffery Smart (U.S. Army Armament, Munitions, and Chemical Command Historian), "Personal communication with Tim McNamara (U.S. Army Aberdeen Proving Ground Support Activity)," (Aberdeen Proving Ground, Maryland: April 1988).

[9]W.J. Taylor, Shell Filling Plant, EA-L-486, AD 495Ø3, (Edgewood Arsenal, Maryland: December 1918).

[10]Marshall and Ellicott, pp. 48-49.

[11]Gary Nemeth (U.S. Army Environmental Hygiene Agency), Personal communication with Tim McNamara (U.S. Army Aberdeen Proving Ground Support Activity)," (Aberdeen Proving Ground, Maryland: April 1988).

[12]ibid.

[13] Peter Mirabella and James Norton (Employees), "Personal communication with Gary Nemeth (U.S. Army Environmental Hygiene Agency)," (Aberdeen Proving Ground, Maryland: circa 1985).

[14] Benjamin M. Gottlieb and Sylvan B. Gordon, Dry Filling of Munitions with WP, 8 inch T21 and 240 mm T6, PDMR 946, (Edgewood Arsenal, Maryland: December 1944).

[15] Nemeth.

To help place the role of the WP Processing Plant in perspective, it is necessary to understand the impact of chemical warfare during World War I, and how that development came to effect the Edgewood Area. The following history of the Edgewood Area of APG is extracted from the Development and Readiness Command (DARCOM) Historic Building Inventory of APG.

EDGEWOOD AREA OF ABERDEEN PROVING GROUND

One special area that came under the jurisdiction of the Ordnance Department in World War I was chemical warfare. Since the Ordnance Department's mission was to procure all weapons necessary for fighting wars, chemicals came under that jurisdiction from the day that they were first used in the battle of Ypres, Belgium, in 1915. Very little information about the production and use of the chemicals involved in the warfare was known here when the United States entered the Great War in April, 1917. The British and French Allies supplied as much information as they could to the Trench Warfare Section of the Ordnance Department under Lieutenant E. J. W. Ragsdale in Washington, D.C. It was quickly decided that America, too, needed toxic chemical-filled projectiles in order to fight effectively with the Allies in Europe, and the race began to develop, produce, fill shells, and ship chemicals as soon as possible to the American troops in Europe.

A plan was devised to build a shell filling plant near good transportation routes to receive the chemical materials manufactured and shipped by private industry. The site chosen for this activity was located near Edgewood, Maryland, on the newly acquired Aberdeen Proving Ground site. This area was located near the Pennsylvania Railroad between Baltimore and Philadelphia and on the Bush River close to the Chesapeake Bay for trans-Atlantic shipping. Construction began on the first shell filling plant on November 1, 1917, on the part of the proving grounds then known as Gunpowder Neck Reservation.

It became obvious that the plan for shipping chemicals to the Gunpowder Neck Reservation would not fulfill the requirements for war. The major four chemicals used in World War I were chlorine, chlorpicrin, phosgene, and mustard gas. None was in wide use in the United States. Only chlorine and a small amount of phosgene were being commercially produced here. Moreover, the private sector was reluctant to start producing the chemicals because of the extensive research needed to devise quantity and quality methods of manufacture, the danger inherent in the chemicals themselves, and the short-lived value of production. After the War, toxic chemical plants would be essentially useless. A further deterrent to the plan for offsite production was a ruling by the Director General of Railroads stating that all toxic materials had to be shipped by special train. This dramatically increased the costs of shipping. By December, 1917, the plan for the Gunpowder Neck Reservation was revised to include the proposed chemical production facilities directly at the site. Construction began immediately.

The first two mannfacturing plants to be constructed were the chlorpicrin plant and the phosgene plant. Chlorpicrin, a lethal tear agent, was used by itself and mixed with other gases. The plant was completed and in production by June, 1918. Phosgene, a lethal choking agent, became responsible for more than eighty per cent of World War I chemical agent fatalities. The phosgene plant, begun in March, was ready for production by July, 1918. Other chemicals determined necessary for war were mustard gas and chlorine.

Mustard gas, a blistering agent, had been first used by the Germans in July, 1917. American military experimenters worked hard trying to devise safe methods for its manufacture at the Gas Service's American University Camp in Washington, D.C., and at private and other government research facilities throughout the East and Midwest. After much experimentation, researchers felt sufficiently knowledgeable and confident enough to begin large scale manufacture in April, 1918. It had already been decided to erect a mustard gas producing plant at the Gunpowder Neck Reservation, but construction was delayed until the process had been determined safe enough. Construction began in May, 1918; production commenced in June. It was the only mustard gas plant in actual production by the end of the war.

Chlorine was the only chemical used in World War I that had been produced commercially in any quantity in the United States before the war. It was a basic ingredient in the manufacturing processes of other chemicals. Not surprisingly, the commercial quantity fell far short of war time needs. On May 11, 1918, ground was broken for a new chlorine plant at the Gunpowder Neck Reservation. It was designed and constructed by the Samuel M. Green Company of Springfield, Massachusetts, using the electrolytic apparatus of the "Nelson Cell". When completed, it was the largest single chlorine and caustic soda plant in the country. Although operational by August, actual production began in September, 1918.

By its commitment to chemical production at Edgewood, the Army succeeded in interesting some private firms located in the East and Midwest to manufacture more of the needed chemicals. The Army agreed to pay for the construction costs of five chemical manufacturing plants while private companies operated them. Another four plants were both owned and operated by the Army. Although these nine plants were also being built to manufacture the same chemicals as at the Gunpowder Neck Reservation, the largest concentration of manufacturing activity was at Edgewood, Maryland.

The increased importance of chemicals in warfare was reflected in changes of the organizational structure dealing with chemicals throughout 1918. Originally under the jurisdiction of the Trench Warfare Section of the Ordnance Department, the various chemical activities were soon organized into one separate bureau in the Ordnance Department under the administration of Colonel William H. Walker in January, 1918. On May 4, 1918, General William L. Sibert, Director of the Gas Service, took charge of the activities at the Gunpowder Neck Reservation. At that time, the name was changed to the Edgewood Arsenal. In June, the Edgewood Arsenal became the center of the newly created Chemical Warfare Service. This entity, now entirely separated from the Ordnance Department, was charged with the responsibility for research, development, supply, and manufacture of all offensive and defensive items in the chemical warfare field, including chemicals themselves, projectiles, and gas masks.

Throughout 1918, Edgewood Arsenal continued to grow. What had been farmland planted to winter wheat in the fall of 1917 was rapidly transformed in less than one year. By October 1, 1918, five hundred fifty-eight buildings had been constructed including the following: eighty-six cantonments housing eight thousand five hundred men, five officers barracks for two hundred ninety

men, a hospital unit of thirty-four buildings with a four hundred twenty man capacity, administration buildings, one forty-man chemical laboratory, one chlorpicrin plant, one phosgene plant, one mustard gas plant, one chlorine plant, and two shell filling plants. Fifteen miles of improved roads, twenty-one miles of standard gauge railroad, and fifteen miles of narrow gauge railways were also constructed. Three power houses and two water systems providing 9.5 million gallons of salt water and 2 million gallons of fresh water a day were successfully installed.

In the construction of Edgewood, the Army realized that it was making a permanent commitment in terms of time, materials, and human lives. Safety and security were primary concerns throughout the construction and production history of Edgewood. All the plants were constructed solidly, with the most up-to-date equipment that the technology of the time could produce. The buildings were well ventilated and mechanized to their maximum capacity in order to minimize human accidents. This concern for safety and security extended even to the men employed at Edgewood. Although civilian labor was used to construct the arsenal, the Army decided that, because of the potential dangers, operations would be entirely managed by enlisted men.

The men stationed at Edgewood were non-rotating troops for the most part. Their contribution to the war effort was in their manufacturing activities. Their lives at Edgewood were similar to most other bases. There were Y.M.C.A. facilities, baseball diamonds, Knights of Columbus meeting halls, and a fine athletic field with running tracks. There were also assembly halls with "moving picture machines" and a forty-two piece band made up of men from the plants. A major difference between the barracks at Edgewood and those at Aberdeen was the fact that the ones at Edgewood were constructed out of structural clay tile rather than wood. Although life at Edgewood may have seemed easier than being sent overseas, the danger of the situation was very real. During the manufacturing operations in 1918, there were nine hundred twenty-five casualties; only four were fatal: three people died of phosgene, and one, of mustard gas.

When the Armistice was declared on November 11, 1918, chemical production at Edgewood Arsenal stopped. The gas plants and the shell filling plants became silent. An inventory of the manufacturing facilities at the arsenal showed it capable of the following output:

Facility	Daily capacity
Chlorine and caustic soda plant, including chlorine plant of Nelson Cells	100 tons
Caustic soda evaporation and concentration plant	116 tons
Chemical plants including:	
Sulphur chloride plant	40 tons
Liquid chlorine plant	100 tons
Phosgene plant	80 tons
Chlorpicrin plant	22 tons
Mustard gas plant	100 tons

Shell filling plants, including:	
Plant for 75 mm. shells	33,000 rounds
Plant for 75 mm. and 4.7-in. shells	25,600 rounds
Plant for 115 mm. and 6-in. and 8-in. shells	20,000 rounds
Plant for 9.2-in. and 240 mm. shells	under construction
Plant for filling gas grenades	20,000 rounds
Plant for filling smoke grenades	20,000 rounds
Plant for filling smoke shells	700 rounds
Plant for filling incendiary drop bombs	2,000 rounds
Plant for filling Stokes mortar bombs with smoke material	6,300 rounds
Plant for filling Livens projectiles	1,200 rounds

Often, however, the manufacturing capabilities did not match the actual production. Mustard gas was only being produced at thirty tons a day because of changes in its method of production. The phosgene plant produced twenty tons of its eighty tons a day capability. For the shell filling plants, chemical production outstripped the supply of shells and boosters needed to assemble the projectiles. There were also shortages of shell supplies which hampered the assembly and shipment of weapons overseas.

World War I was a significant beginning for Edgewood Arsenal. The construction and the production capabilities of four major chemical plants erected on one site in one short year represented an achievement in the cooperation among the military, industrialists, research chemists, and construction engineers. From knowing nothing, the United States had become a leader in the chemical warfare field by the end of the War. World War I created a need for chemical warfare which the military establishment decided to answer. In order to do a good job, the military recruited top research chemists from both universities and industry. Working in various research laboratories, these chemists experimented with the chemical reactions, improved on them, and readied them for production. Then on a site and with money given by the military; chemists, industrialists, engineers, and the military watched the transformation of experimental processes into actual machinery and buildings capable of producing tons of chemicals a day. It was a massive enterprise, successfully completed. Although several other plants were being constructed, Edgewood Arsenal was the largest production facility and the only one to produce all four chemicals used in World War I. It became a complex so efficient that production at Edgewood Arsenal was more effective than either that of the Allies or the threat forces. At the end of World War I, it was reported that even the German chemical plants were copying American methods.

Of the incredible investment of time, talent, monetary resources, and energy that occurred at Edgewood Arsenal during World War I, a surprising number of buildings remain. These buildings represent the shells of the chemical processes that occurred within them. The actual machinery no longer exists in the structures; it has been removed over the years as the mission of Edgewood Arsenal has changed. None of the original chemical plants remain

intact, but there are representative remnants of them. Four buildings constructed as the phosgene plant (#E5354, #E5352, #E5360, and #E5357) and two from the mustard gas plant (#E5440, and #E5452) still remain. The chlorine liquification plant building (#E5325) still stands, but nothing of the highly praised 1918 chlorine and caustic soda plant remains. A 1918 white phosphorous plant (#E5032) still stands along with its storage magazines (#E5044, and #E5046). In the assembly plant area, the original generating and heating plant (#E5126) stands as well as the three original shell dumps (#E5158, #E5165, and #E5179). One of the comp houses (#E5137) and one storehouse of boosters and adaptors (#E4060) remain. Some auxilliary buildings such as a well house, two fire stations, a change house, and several magazines also stand. Other areas surviving from World War I include a 1918 barracks complex, an officers mess and guest house, and part of the original hospital and administration area. The buildings built during World War I, particularly those built in the industrial area, were built for specific purposes and inherent in those purposes, was a need for keeping technology and production facilities as up-to-date as possible. Those buildings which could be adapted to fill new discoveries were so adapted; those that had outlived their purposes were demolished. The Chemical Warfare Service was proud of its World War I record and looked towards future service as a vital part of national defense.

After November, 1918, the Chemical Warfare Service and Edgewood Arsenal faced a sharp role change. What had seemed a natural and necessary response in war time, seemed inhuman and ungodly in peace time. Statistics that the Chemical Warfare Service had been proud to publish right after the war, became monstrous to a population reeling under the horrors of war. Instead of receiving accolades for a job well done, the Chemical Warfare Service found itself desperately trying to justify its existence and its record both in terms of the morality of chemical warfare and its firm belief that chemicals would be a vital part of any war fought in the future.

This struggle was again reflected in organizational changes. Immediately after the Armistice, the Chemical Warfare Service reverted to the jurisdiction of the Ordnance Department. In 1920, it gained permanent stature and was established as a separate branch of the Army. Its peacetime instructions were to maintain "a competent body of chemical warfare specialists with facilities for continuous research and experimentation" and to keep "in touch with civilian agencies for chemical research and chemical industries capable of being converted for the production of wartime material." However, funding was cut sharply and the organization severely pruned.

The far flung activities of the Chemical Warfare Service were concentrated at its headquarters, Edgewood Arsenal. The offsite chemical manufacturing plants were dismantled and returned to peacetime use. The machinery used in the gas mask plant located on Long Island during the war was dismantled, shipped to Edgewood, and installed in a new building. The testing done at the chemical proving grounds at Lakehurst, New Jersey, was halted and the testing functions consolidated at Edgewood. The Chemical Warfare School originally located at Lakehurst, New Jersey, was also transferred to Edgewood. The actual chemical plants at Edgewood were placed on stand by readiness status

and was placed in a storage depot on site. All was in readiness in case of a new conflict.

In the climate of censure concerning the use of chemical agents, readiness for any new conflict was not a valid argument for the existence of a Chemical Warfare Service to opponents who claimed that the war to end all wars had just been fought. Instead, the Chemical Warfare Service emphasized the peace applications of their chemical research. Inventing a better gas mask and protective clothing were always important ongoing research projects. Not only would such protections be necessary for any future war, but they also were useful accident prevention devices for private industry. Other military research and development projects included dispersion of chemical agents from airplanes, smoke-producing materials for smoke screens, Livens Projectors, and the 4.2 inch chemical mortar. Yet, the most highly publicized work of the Chemical Warfare Service during peacetime included combating marine borers, boll weevils, barnacles, and rats possibly carrying Bubonic Plague on immigrant ships.

In 1922, Edgewood Arsenal was subdivided by the General Order #40, giving part to the Ordnance Department for the creation of Fort Hoyle for the Sixth Field Artillery. Fort Hoyle, named in honor of Brigadier General Eli D. Hoyle, and the Chemical Warfare Service co-existed peacefully in the World War I barracks that still exist at the southern part of Edgewood. When World War II broke out, the Sixth Field Artillery moved on to battle and the Chemical Corps reclaimed its original territory.

Very little new construction was accomplished at Edgewood Arsenal between the Wars. The actual manufacturing plants, which had been placed on stand by readiness status, gradually fell into disrepair. There was no massive Work Projects Administration (WPA) sponsored permanent construction at Edgewood as there was at Aberdeen Proving Ground. Some officers housing was built during the 1920's; it was all wood framed and shared by officers from both the Chemical Warfare Service and Fort Hoyle. During the 1930's, standardized Quartermaster house plans exactly the same as one type at Aberdeen Proving Ground in the Plumb Point region were built out of brick. One other permanent construction was the Fort Hoyle Riding Hall built in 1938 out of Port Deposit Granite. It was converted to a gymnasium in 1941.

In preparation for possible conflict during the prelude to World War II, the Chemical Warfare Service was infused with money because it was feared that gas could/would be used again. It was deemed best to be ready. Toward the end of the 1930's, the Chemical Warfare Service gained approval for reopening its mustard gas manufacturing plant at Edgewood Arsenal for limited production. As rumors of war increased, the phosgene and chlorine plants underwent major rehabilitation. New plants were constructed. Among these were the World War II Adamsite Plant, a cyanide plant, and a CC_2 (a chemical for protective clothing) plant. With production facilities expanded, more storage space was needed. The storage depot was expanded with new structural clay tile magazines and Transite-sided warehouses. The eastern part of Edgewood Arsenal became designated as the Eastern Chemical Depot, the first

and only chemical storage facility on the East Coast. More storage facilities filled the western sector of Edgewood. Several new chemical shell filling plants were built.

As activity increased, so did personnel. New cantonments were constructed in late 1940 and early 1941. These were temporary wood buildings constructed following the early 700 series standardized mobilization plans. Monies were also approved for the construction of a major new chemical laboratory.

Until the laboratory was completed in 1942, the research functions of the Chemical Warfare Service were scattered throughout the country in any research facility that was offered to it. Throughout the War, as the functions of the Chemical Warfare Service expanded, Edgewood Arsenal was no longer large enough to encompass all activities. It became the headquarters and was redesignated the Chemical Warfare Center in 1942. New chemical plants owned and operated by the Army were constructed in the South and West. The Chemical Warfare Service remembered that the private sector could/would not produce the toxic materials needed for war; it was easier to produce the chemicals themselves. As Edgewood proper became too small for chemical testing, a new proving ground was established out West. Four other chemical depots were set up in various regions of the country. With newer arsenals undertaking the major chemical production functions, the role of Edgewood became oriented less towards actual chemical production and more towards administration, research and development, limited testing, and production of experimental chemical agents in small pilot plants.

With the end of World War II, the Chemical Warfare Center continued to serve as headquarters for the Chemical Corps and was redesignated as the Army Chemical Center. The Chemical Corps remained strong although chemical warfare had not been used on the battlefields as it was during World War I. Moreover, the prevailing philosophy was that a strong offense on the part of the United States was the safest security against such use. Therefore, research continued at the Army Chemical Center. Not only was research conducted on nerve agents and their dissemination, but also much work was conducted on protective measures. The forerunner of the United States Environmental Hygiene Agency was established to study the effects of agents and the newest problems of radiation and radiological fallout. Other research was continued on napalm, flame throwers, screening and signalling smokes, and herbicides.

In 1951, the Chemical Corps was reorganized into a three command structure. The Headquarters, Research, and Engineering Command was established at the Army Chemical Center. It had control over all research and engineering installations and activities of the Chemical Corps. The Chemical Warfare School was placed in the Chemical Corps Training Command and its activities were transferred from Edgewood to Fort McClellan, Alabama. In 1962, the general reorganization of the army resulted in the redesignation of the Army Chemical Center back to Edgewood Arsenal. On July 1, 1971, Edgewood Arsenal became a part of Aberdeen Proving Ground and its mission functions became those of a Class II Activity under the United States Army Munitions Command.

Since World War II, new construction at Edgewood Arsenal has been new laboratories and administration buildings for various agencies such as, The United States Army Environmental Hygiene Agency (1967), The Ralph J. Truex Laboratory (1968), Veterinary Medicine (1979), and the United States Army Medical Research Building (1968). These show the shift at Edgewood Arsenal away from production towards administration and research. Another area of new construction has been modernized housing with Wherry Housing (1951), new enlisted mens barracks (1962), and bachelor officers quarters (1969), along with such support facilities as a chapel (1963), dispensary (1963), and enlisted men's service club (1960). Aside from new construction, older buildings have been rehabilitated and altered in the continuing quest of remaining modern in order to fulfill a mission. It is now a military policy that the United States will not use chemical and biological agents first in any military action, but will-retaliate if fired upon. Yet, Edgewood Arsenal still serves a vital mission in the military establishment today and will continue its function in the future. (7)

The following six pages are schematic plans of various aspects of the building from various dates. Originals are maintained in the Engineering Office, Directorate of Engineering and Housing, Aberdeen Proving Ground, Maryland.

A. Plot plan developed for alterations to Building 99, August 5, 1943.

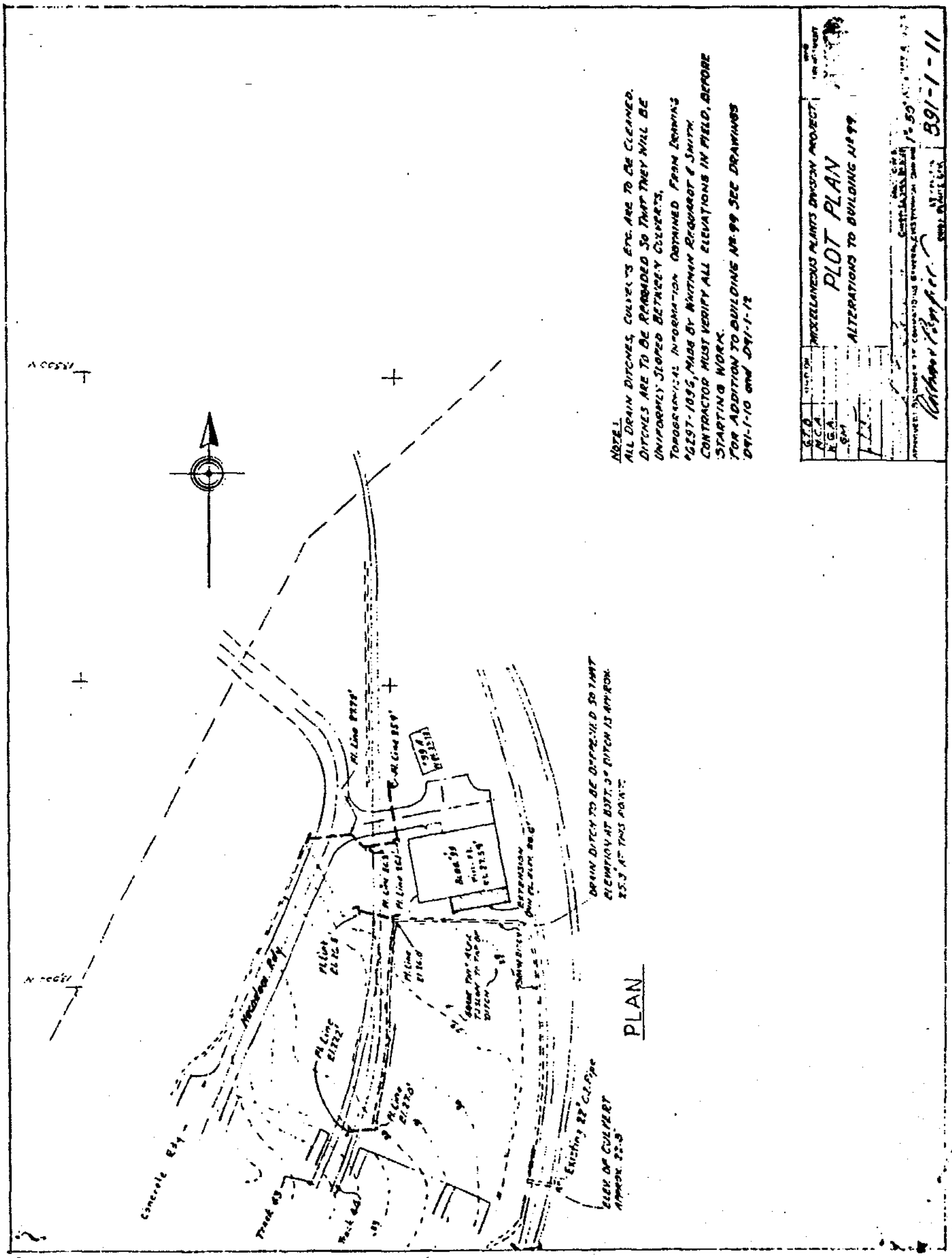
B. Plan and elevation, August 16, 1943.

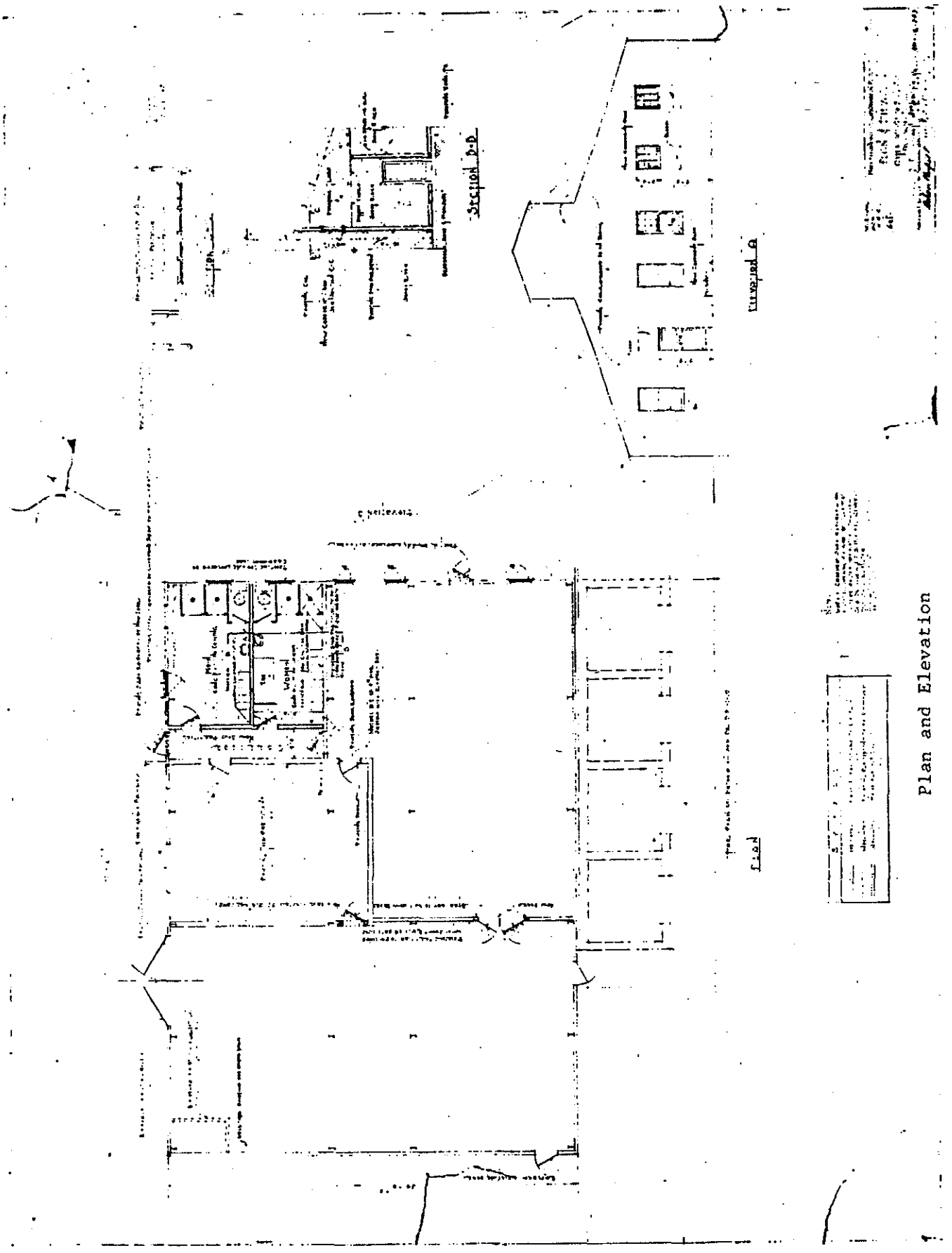
C. General electrical notes, August 1943.

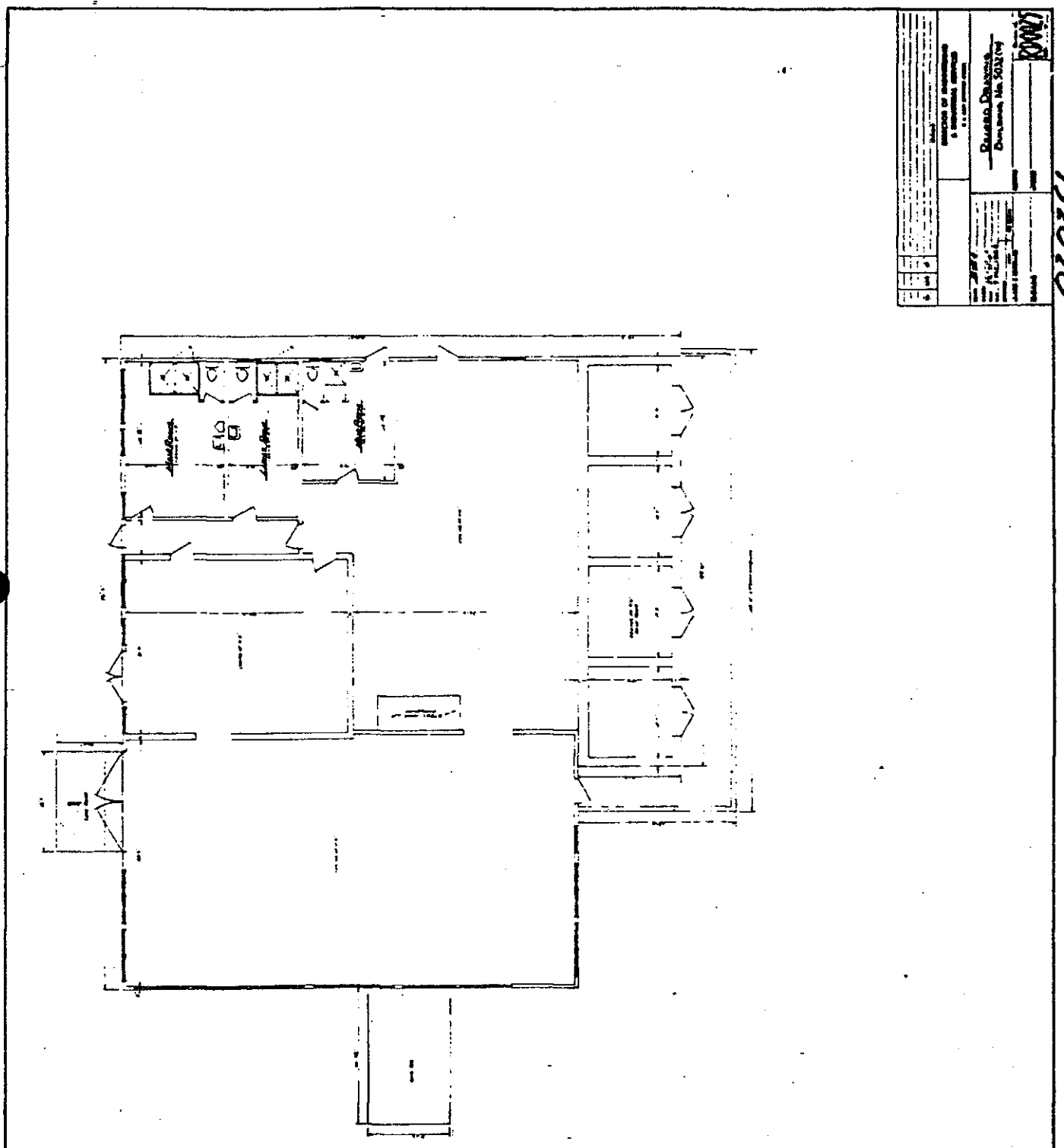
D. Loading ramp details, January 3, 1944.

E. Diagram of sump drainage, August 8, 1956.

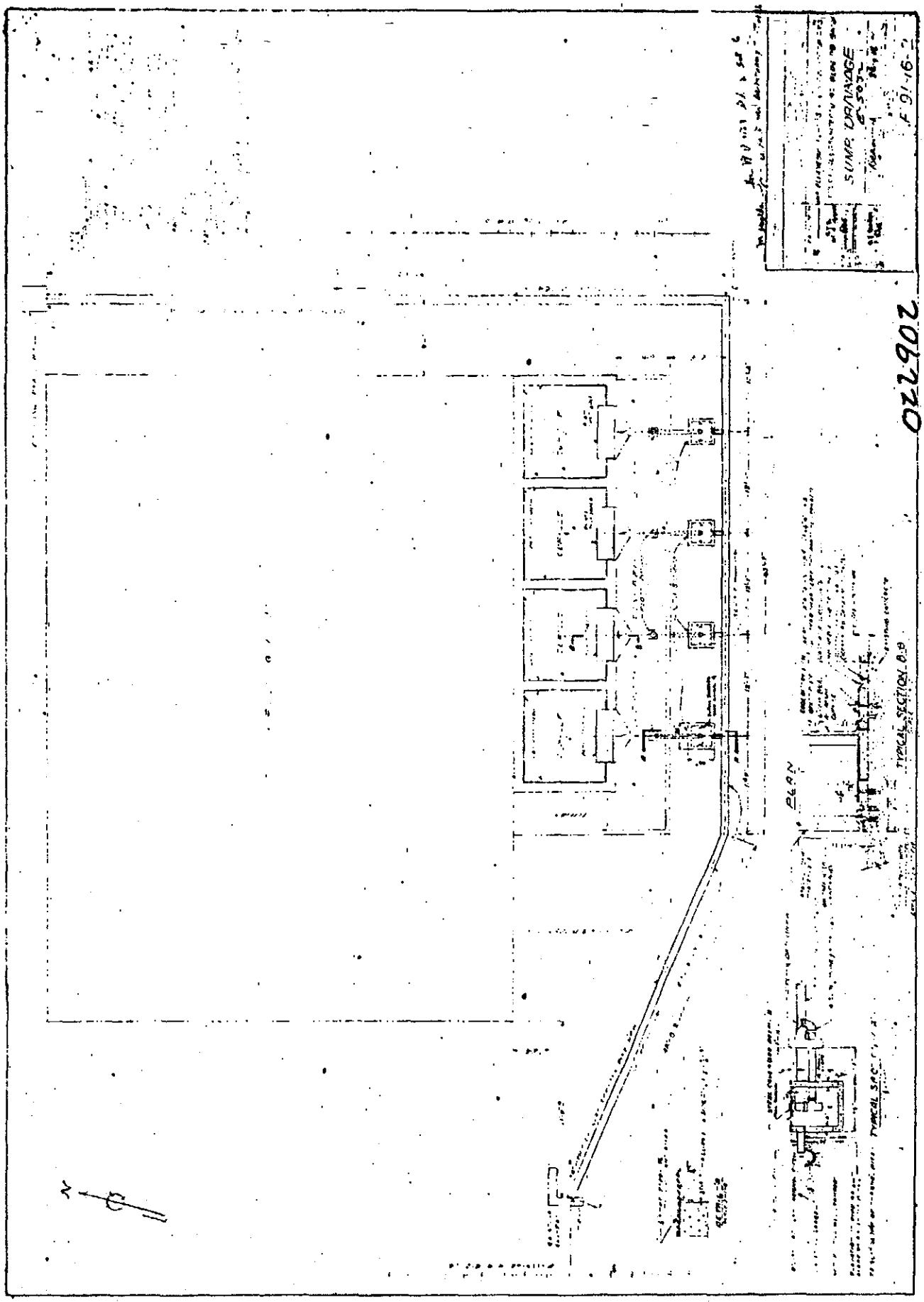
F. Record drawing of Building E5032, October 9, 1964.


NOTES:
ALL DRAIN DITCHES, CULVERTS ETC. ARE TO BE CLEANED.
DITCHES ARE TO BE REGRADED SO THAT THEY WILL BE UNIFORMLY SLOPED BETWEEN CULVERTS.
TOPOGRAPHICAL INFORMATION OBTAINED FROM DRAWING #G297-1095, MADE BY WHITMAN REQUARDT & SMITH.
CONTRACTOR MUST VERIFY ALL ELEVATIONS IN FIELD, BEFORE STARTING WORK.
FOR ADDITION TO BUILDING No 99 SEE DRAWINGS D91-1-10 and D91-1-12
MISCELLANEOUS PLANTS DIVISION PROJECT
PLOT PLAN
ALTERATIONS TO BUILDING No 99
D91-1-11
PLAN


Section B-B
Plan and Elevation



Building No. 5032 (99)


SUMP DRAINAGE
F 91-16-2
TYPICAL SECTION B-B
PLAN
N

GENERAL ELECTRICAL NOTES

1. NO WIRING SHALL BE SMALLER THAN #12 A.W.G. NOR BE CONTAINED IN CONDUIT SMALLER THAN ¾" I.M.C.

2. ELECTRICAL EQUIPMENT, ITS WIRING AND INSTALLATION SHALL CONFORM TO THE LATEST NATIONAL ELECTRIC CODE AND TO THE STANDARD OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

3. ELECTRICAL WIRING, INSTALLATION AND EQUIPMENT IN AREAS INDICATED ON THE DRAWINGS AS HAZARDOUS LOCATIONS SHALL BE INSTALLED IN STRICT CONFORMITY WITH THE NATIONAL ELECTRIC CODE REQUIREMENTS FOR SUCH LOCATIONS.

4. ALL ELECTRICAL SWITCHES, MOTOR CONTROLLERS, PANEL BOARDS, ETC. WHICH ARE TO BE MOUNTED ON THE OUTSIDE OF BUILDINGS, EXCEPT THOSE OF WEATHER-PROOF CONSTRUCTION, SHALL BE PROTECTED BY WEATHER-PROOF ENCLOSURES.

5. ILLUMINATION VALUES GIVEN ARE AVERAGE AND FIXTURES SHALL BE SIZED AND SPACED SO AS TO APPROXIMATE THE AVERAGE VALUE AT THE WORKING PLANE. IN THE SELECTION OF SIZE OF LAMPS AND NUMBER OF FIXTURES AN 80% MAINTENANCE FACTOR SHALL BE USED SO AS TO ALLOW FOR 20% DEPRECIATION IN LAMPS, FIXTURES AND REFLECTING MEDIA.

6. IN THOSE AREAS WHERE THE AMOUNT OF ILLUMINATION IS NOT NOTED ON THE DRAWINGS, THE CONTRACTOR SHALL PROVIDE A TYPE AND AMOUNT OF ILLUMINATION AS RECOMMENDED BY THE ILLUMINATING ENGINEERING SOCIETY FOR SUCH AREAS.

7. THE CONTRACTOR SHALL FURNISH AND INSTALL, WHERE DEEMED NECESSARY BY THE CONTRACTING OFFICER, A COMPLETE SYSTEM OF LIGHTNING PROTECTION CONSISTING OF AERIAL POINTS, CONDUCTORS AND THEIR SUPPORTS, A GROUND LOOP AROUND THE BUILDING, GROUNDS, AND OTHER APPURTENANCES NECESSARY FOR ADEQUATE PROTECTION.
THE GROUNDING OF ALL METAL PARTS AND EQUIPMENT INCORPORATED IN THE STRUCTURE OF THE BUILDINGS OR INSTALLED IN THE BUILDINGS SHALL BE AN INTEGRAL PART OF THE LIGHTNING PROTECTION SYSTEM.

8. CURRENT CHARACTERISTICS FOR THE INSTALLATION WILL BE FURNISHED BY THE CONTRACTING OFFICER. ALL ELECTRICAL EQUIPMENT INSTALLED SHALL BE SUITABLE FOR USE WITH THE SPECIFIED CURRENT.

9. IT SHALL BE THE DUTY OF THE CONTRACTOR TO COOPERATE WITH WAYS WITH THE MANUFACTURERS OF EQUIPMENT TO BE INSTALLED IN THE BUILDINGS AND WITH OTHER CONTRACTORS, TO INSURE A COMPLETE AND WORKABLE ELECTRICAL INSTALLATION.

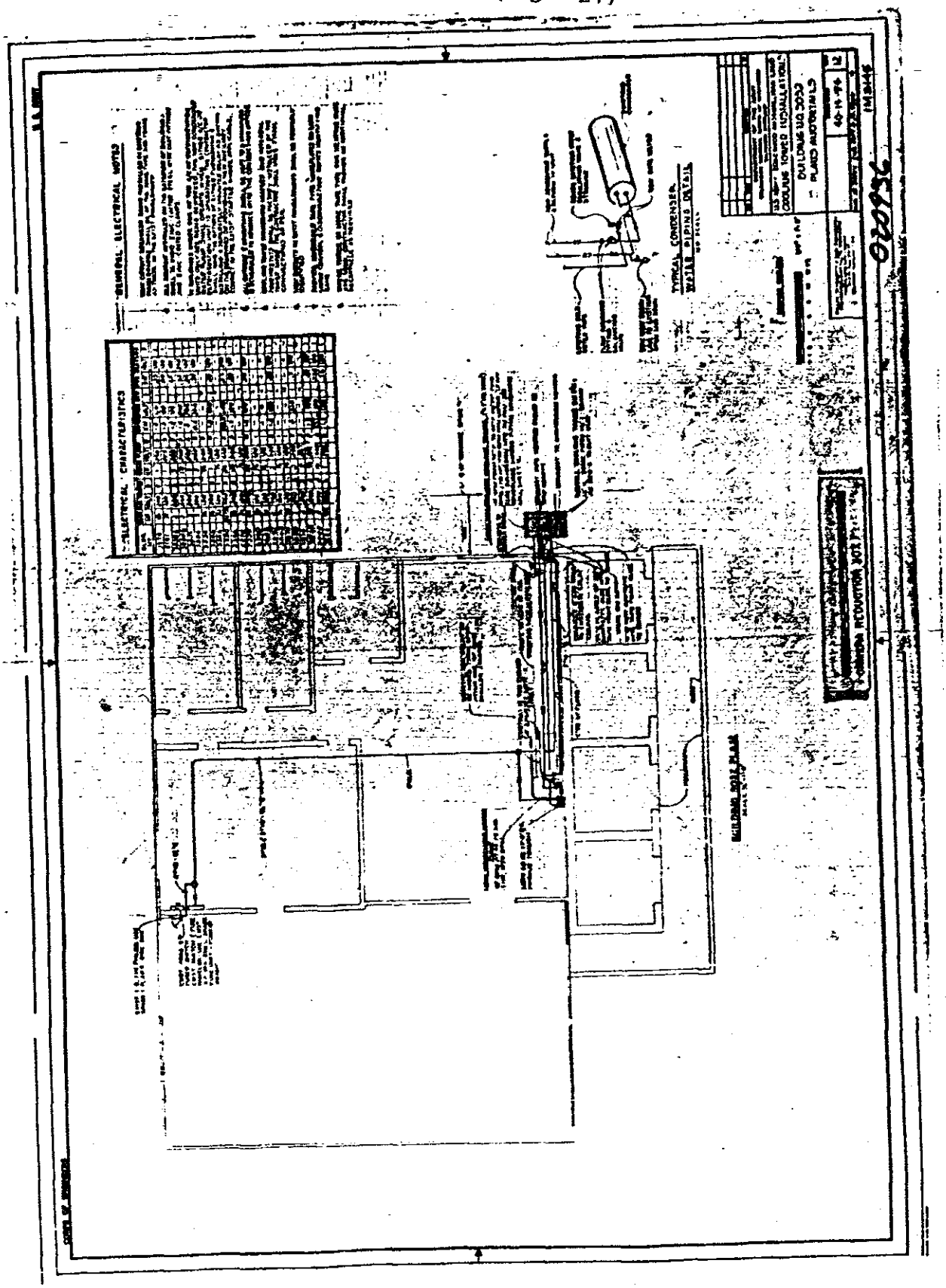
10. THE CONTRACTOR SHALL NOT TAKE ADVANTAGE OF ANY OMISSION OF DETAILS IN SPECIFICATIONS OR DRAWINGS, BUT WILL BE REQUIRED TO COMPLETE THE INSTALLATION ACCORDING TO THE INTENT OF THE DRAWINGS AND SPECIFICATIONS AND TO THE SATISFACTION OF THE INSPECTOR. THE CONTRACTOR WILL BE HELD RESPONSIBLE THAT HE ASKS FOR ANY NECESSARY DETAIL OR GENERAL SPECIFICATIONS WHICH OTHERWISE HAVE NOT BEEN SUPPLIED HIM.

11. PRIOR TO PROCEEDING WITH ANY ELECTRICAL WORK THE CONTRACTOR SHALL SUBMIT TO THE CONTRACTING OFFICER FOR APPROVAL, WORKING DRAWINGS (IN TRIPLICATE) OF THE INSTALLATION HE PROPOSES TO FURNISH.

12. FINAL AUTHORITY WITH MATTERS PERTAINING TO ELECTRICAL INSTALLATION SHALL REST WITH THE CONTRACTING OFFICER.

GENERAL ELECTRICAL NOTES
ALT. BLDG. 99
ARCHITECTURAL

C-91-1-12



Photocopy of drawing (original negative in the Engineering Office, Directorate for Engineering and Housing, Aberdeen Proving Ground, Maryland) photographer and date unknown, cooling tower overview.